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RESEARCH RESOURCES OF BUREAU OF AGRICULTURAL AND INDUSTRIAL CHEMISTRY in Four Regional Research Laboratories

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and Eleven Other Branch Stations

AGRICULTURAL RESEARCH ADMINISTRATION
U. S. DEPARTMENT OF AGRICULTURE
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FOREWORD

The Bureau of Agricultural and Industrial Chemistry is one of the Research Bureaus in the Agricultural Research Administration of the U. S. Department of Agriculture. Its facilities are designed to solve problems concerned with the utilization of a wide variety of agricultural commodities and its personnel are experienced in research in chemistry, biochemistry, microbiology, physics, pharmacology, food and textile technology, engineering and other related sciences and technologies. The scope of the Bureau's technical resources in equipment and personnel is outlined in this pamphlet for the information of interested research agencies.

RESEARCH RESOURCES OF THE BUREAU OF AGRICULTURAL AND INDUSTRIAL CHEMISTRY

July 1952

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INTRODUCTION: FUNCTION AND ORGANIZATION OF BUREAU

The function of the Bureau of Agricultural and Industrial Chemistry is to provide new and extended outlets for agricultural products through scientific research. As progress is made, the farmer is benefited by receiving better and more stable prices for his products; industry and labor are provided with new opportunities, and the consumer is offered new or improved products or lower prices for existing products because of gains in processing efficiency.

The Bureau had its inception in 1862 and is one of the oldest agencies within the Department of Agriculture. Today the Bureau's facilities include four large regional research laboratories plus eleven other field laboratories. The location of the laboratories, their fields of research, and the regions which they serve, are indicated in the accompanying map.

The scope of the research activities of the Bureau is indicated in the following list of utilization investigations on agricultural commodities and their derived products which are included in its research program.

A CEREAL AND FORAGE CROP UTILIZATION INVESTIGATIONS

1. Corn, Wheat, and Other Cereal Crops
2. Rice
3. Alfalfa

B. COTTON AND OTHER FIBER UTILIZATION INVESTIGATIONS

1. Cotton Lint
2. Wool

C. FRUIT AND VEGETABLE UTILIZATION INVESTIGATIONS

1. Deciduous Fruits
2. Citrus Fruits
3. Vegetables
4. Fermentation (Pickles)

D. OILSEED UTILIZATION INVESTIGATIONS

1. Southern Oilseeds - including Cottonseed, Peanuts and Tung Nuts
2. Northern Oilseeds - including Soybeans and Safflower

E. SUGAR AND SPECIAL PLANTS UTILIZATION INVESTIGATIONS

1. Cane-, Beet-, and Sorgo Sugar
2. Candy
3. Honey and Maple Products
4. Tobacco
5. Tanning Materials and Leather
6. Pine Gum Chemicals - Gum Turpentine and Gum Rosin
7. Guayule Rubber
8. Special Plants

F. POULTRY, DAIRY AND ANIMAL PRODUCTS UTILIZATION INVESTIGATIONS

1. Poultry Products
2. Milk Products
3. Animal Products

G. AGRICULTURAL RESIDUES UTILIZATION INVESTIGATIONS

1. Wheat Straw
2. Corncobs and Nut Shells
3. Sugarcane Bagasse

H. BASIC INVESTIGATIONS OF AGRICULTURAL PRODUCTS (Apart from basic research conducted in connection with commodity program as designated in A through G above)

1. Biologically Active Compounds
2 Enzymological Investigations
3. Immunochemical Investigations
4. Pharmacological Investigations

The overall activities of the Bureau are administered by the Chief of Bureau from the central Washington office. He is assisted in this task by a staff of five Assistant Chiefs. The regional activities of the Bureau are administered under the general supervision of the Chief by the Directors of the four regional laboratories. The members of the Bureau's administrative staff are listed below:

Office of the Chief of Bureau, Washington, D. C.

G. E Hilbert, Chief
C. F. Speh, Assistant Chief
G. W. Irving, Jr., Assistant Chief
J. R. Matchett, Assistant Chief
W. M. Scott, Assistant Chief
H. A. Donovan, Assistant Chief
* H. P. Newton, Special Representative of the Chief

Eastern Region

P A. Wells, Director, Eastern Regional Research Laboratory, Wyndmoor, Pennsylvania

* H P Newton is currently stationed at Camp Detrick, Frederick, Maryland He is devoting most of his time to the implementation of research activities in the Bureau on problems of interest to the Biological Laboratories of the Chemical Corps at Camp Detrick and the Chemical Laboratories at Army Chemical Center Edgewood, Maryland His attention will be given to other Defense Agencies as the need arises

Northern Region

R. T. Milner, Director, Northern Regional Research Laboratory, 825 North University Street, Peoria, Illinois

Southern Region

C. H. Fisher, Director, Southern Regional Research Laboratory, 2100 Robert E. Lee Blvd., New Orleans, Louisiana

Western Region

M. J. Copley, Director, Western Regional Research Laboratory, 800 Buchanan St., Albany 6, California

In addition to other duties, Dr. Walter M. Scott has been designated as the liaison representative of the Bureau, and he is in a position to supply upon request more detailed information concerning the services and facilities outlined herein and to indicate the members of the Bureau staff to be contacted directly for specialized information. Inquiries may be addressed to:

Dr. Walter M. Scott, Assistant Chief
Bureau of Agricultural and Industrial Chemistry
U. S. Department of Agriculture
Washington 25, D. C.

Research Qualifications: Personnel

Of the Bureau's staff of approximately 1300, more than two-thirds are technically trained, including about 189 with Ph.D., 126 with M.S., and 372 with Bachelor Degrees. This scientific group includes 455 chemists, with specialists in analytical, colloidal, organic, inorganic, physical and bio-chemistry; 107 engineers, specializing in chemical, mechanical, electrical, electronic, and architectural engineering; 17 physicists; 23 bacteriologists; 5 pharmacologists; 16 physical scientists; 43 technologists specializing in food, textiles, microbiology, rubber, paper, pine gum chemicals, microscopy, histology and zymology; and 50 specialists in industrial analysis, drafting, mathematics, information services, and tool and instrument development; plus the necessary laboratory assistants.

Research Qualifications: Pilot Plant and Special Laboratory Facilities and Equipment - Arranged According to Fields of Work

Ranking high in American laboratory design, the regional laboratories are 3-story brick or concrete structures plus basement and have basically the same functional "U"-shaped plan. The Administrative sections are located in the base of the "U", with a wing for laboratory research on one side, and a wing for pilot-plant process and product development on the other.

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RESEARCH STATIONS
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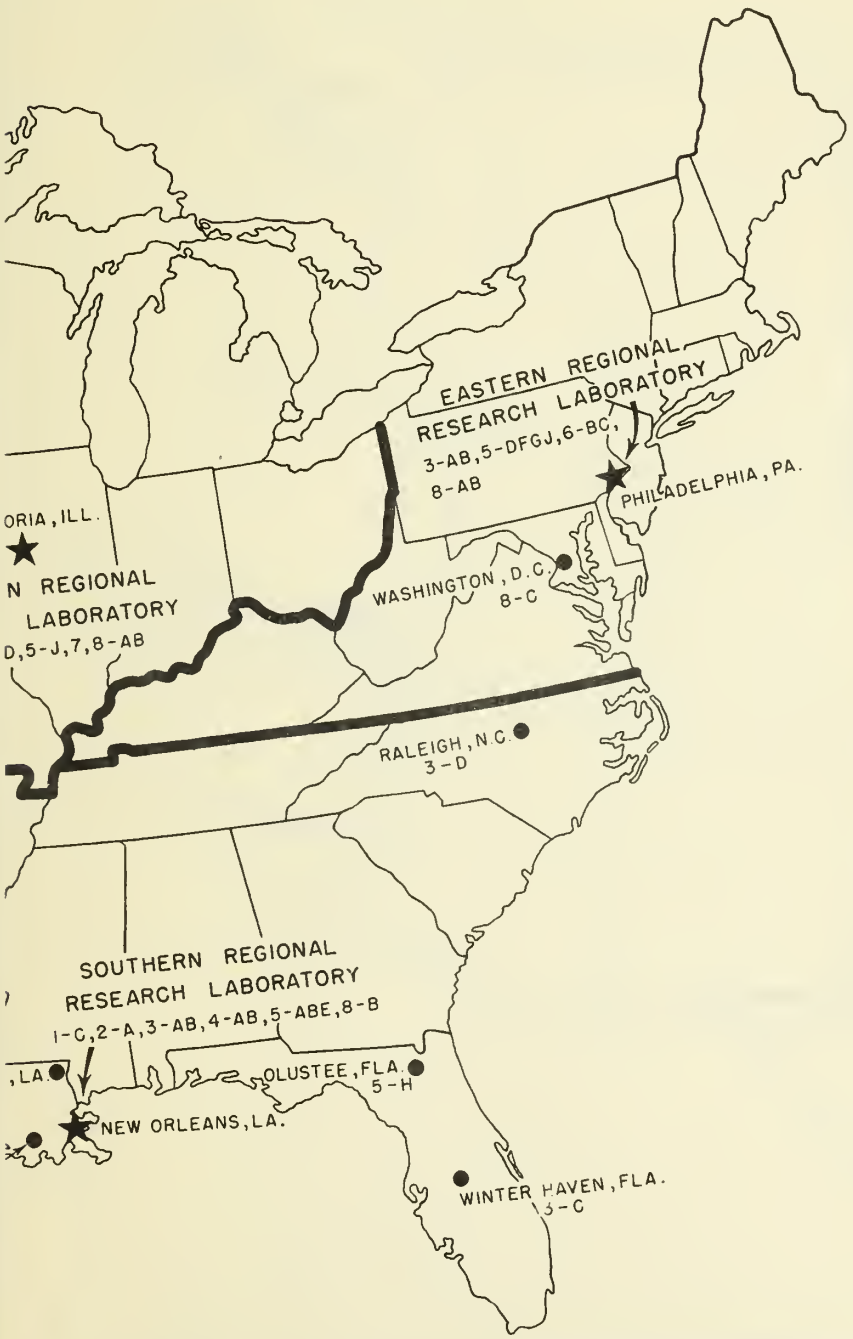

LEGEND

1. CEREAL AND FORAGE CROP UTILIZATION INVESTIGATIONS
   - A. CORN, WHEAT AND CEREAL CROPS
   - B. ALFALFA
   - C. RICE
2. COTTON AND OTHER FIBER UTILIZATION INVESTIGATIONS
   - A. COTTON
   - B. WOOL
3. FRUITS AND VEGETABLES UTILIZATION INVESTIGATIONS
   - A. FRUITS
   - B. VEGETABLES
   - C. CITRUS FRUITS
   - D. FERMENTATION (PICKLES)
4. OILSEED UTILIZATION INVESTIGATIONS
   - A. COTTONSEED AND PEANUTS
   - B. TUNG NUTS
   - C. SOYBEANS
   - D. SAFFLOWER
5. SUGAR AND SPECIAL PLANTS UTILIZATION INVESTIGATIONS
   - A. CANE SUGAR
   - B. SORGO SUGAR
   - C. BEET SUGAR
   - D. HONEY AND MAPLE PRODUCTS
   - E. CANDY
   - F. TOBACCO
   - G. TANNING MATERIALS AND LEATHER
   - H. PINE GUM CHEMICALS
   - I. GUAYULE RUBBER
   - J. SPECIAL PLANTS
6. POULTRY, DAIRY AND ANIMAL PRODUCTS UTILIZATION INVESTIGATIONS
   - A. POULTRY PRODUCTS
   - B. MILK PRODUCTS
   - C. ANIMAL PRODUCTS
7. AGRICULTURAL RESIDUES UTILIZATION INVESTIGATIONS
8. BASIC INVESTIGATIONS OF AGRICULTURAL PRODUCTS
   - A. BIOLOGICALLY ACTIVE COMPOUNDS
   - B. ENZYMOLOGICAL INVESTIGATIONS
   - C. IMMUNOCHEMICAL INVESTIGATIONS
   - D. PHARMACOLOGICAL INVESTIGATIONS

AGRICULTURAL RESEARCH ADMINISTRATION

BUREAU OF AGRICULTURAL AND INDUSTRIAL CHEMISTRY
REGIONAL DIVISIONS AND RESEARCH STATIONS

JULY 1952

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U.S. DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH ADMINISTRATION

The Bureau's pilot-plant and special laboratory facilities may be classified as follows:

A. FOOD AND FEED PROCESSING AND PRESERVATION

1. Preparation

a. Fruits and Vegetables - Complete equipment for washing, blanching, post-blanch cooling, sorting, hulling, shelling, peeling, cutting, slicing, dicing, reaming, coring, pulping, and grinding.

b. Poultry - Complete experimental equipment for slaughtering, scalding, plucking, eviscerating, and packaging poultry for frozen storage.

2. Processing

a. Concentrating and Clarifying - Complete forced and natural circulation vacuum evaporating equipment for concentrating liquid food products; crystallizing facilities include continuous low temperature units for fractionating animal fats and oils; special maple sirup evaporating equipment; fractionators, homogenizers, essence stripping units for frozen or heat processed juices and purees; air float separators, clarifiers (milk separator type), rotary vacuum filters, filter presses, and a variety of centrifuges (including continuous centrifuges for producing white and sweet potato starch); countercurrent extraction equipment for both flammable and non-flammable solvents (oilseeds); and vacuum pot stills.

b. Drying - Complete range of cabinet-, tray-, vacuum shelf-, tunnel-, drum-, rotary kiln-, spray- and freeze-driers.

c. Canning - Complete range of equipment including canning retorts and filling and sealing equipment for canning and dehydrocanning.

d. Freezing - Complete range of equipment for air-blast, immersion, pan and slush freezing, and dehydrofreezing.

e. Fermentation (Pickles) - Brining, salting and pickling equipment.

f. Milling (Dry) - Equipment for cleaning and milling grains and oilseeds for producing wheat flour and other mill products; also roller particle-size analyzer; hammer mills, screens and separators for processing leafy materials and vegetable wastes.

3. **Storage** - Complete range of controlled temperature refrigerators and refrigerated rooms; fluctuating temperature rooms for storage studies; also silage equipment.

4. Yeast Propagators - Continuous machine for preparing and recovering feed products.

5. Miscellaneous Unit Proces Equipment

a. Sweet and White Potato Starch - Two complete model plants equipped for grinding, screening, centrifuging, bleaching, dewatering, and drying the starch; also equipment for recovery of byproduct feeds as substantially continuous process.

b. Starches from Cereal Grains - A pilot-plant for starch production by wet milling, equipped for steeping, grinding, and screening the grain (including degermination of corn) and centrifuging and drying the starch).

c. Vegetable Oil Processing - Complete facilities for refining, bleaching, hydrogenation, filtration, degumming, deodorization, blending, chilling, esterification, autoclaving, and low temperature fractionation; also facilities for preparation of raw or cooked, rolled or flaked meats from oilseeds and for extraction of prepared meats to yield oil and meal products; also equipment for preparation of purified proteins from oilseed meals.

d. Peanut Butter - Complete equipment for roasting, blanching, picking, grinding, homogenizing, stabilizing and packaging; also facilities for oil roasting and salting peanuts.

e. Sugarcane Products - Complete pilot-plant facilities for grinding and processing juices and recovery of byproducts; also small-scale manufacturing and controlled storage facilities for preparation and evaluation of candy products.

f. Sirups and Sugars from Cereal Grains - Complete equipment for acid and enzymatic conversion of starch from cereal grains or flour; evaporation, filtration and crystallizing equipment for making sirups and dextrose.

6. Special Food Laboratory Facilities are required for investigating the composition, modification and deteriorative chemistry of fruits, vegetables, poultry, egg and cereal products. These facilities may be classified as follows:

a. Equipment for determining amino acids, proteins, carbohydrates, oils, fatty acids, minerals, vitamins, and other constituents in food materials.

b. Equipment for preparing protein isolates from oilseed meals, and measuring protein properties, including electrophoresis apparatus and ultracentrifuge.

c. Equipment for microbiological studies on isolation, culture, and identification of yeasts, molds and bacteria, including those related to the fermentation production of vitamins, food acids, and antibiotics for food preservation, as well as those involved in food contamination.

d. Complete equipment for small-scale baking investigations including Farinographs and Extensographs for dough studies.

e. Food appraisal laboratory, including kitchen, taste booths, and computing facilities.

B. TEXTILES AND TEXTILE PROCESSING

1. **Fundamental Chemistry and Physics of Cotton Cellulose** - Complete facilities for studying chemical composition, morphology, fine structure, physical properties, molecular weight, crystallinity, degree of polymerization, "limit" degree of polymerization, swelling capacity, distribution of pore space and heats of wetting. Special equipment includes an electron microscope, X-ray spectrometer, molecular weight facilities (including osmometers, viscometers, ultracentrifuge, diffusion cells, infrared spectrometers, and radioactive tracer equipment) requiring highly trained personnel.

2. **Cotton Mechanical Processing Through Weaving** - Complete flexible pilot-plant facilities for mechanically processing cotton fibers with conventional mill machinery through opening, picking, carding, drawing, roving, spinning, twisting, winding, slashing, and weaving.

3. **Cotton Finishing** - A complete pilot-plant for wet processing includes continuous chemical finishing ranges, pressure kiers, winches, centrifuges, jigs, padders, raw stock and package dyeing machinery, skein processing, tenter frames and driers, and finishing calenders.

4. **Synthetic Protein Fiber Manufacture** - Small scale equipment for producing both bristle and textile fibers from regenerated protein derived from zein, casein, soybeans, cottonseed, peanuts, and from feather keratin. Textile fiber facilities include apparatus for pumping protein solutions through spinnerettes into coagulating baths. Bristle fiber facilities include equipment for forcing heated protein gels through spinnerettes to form the characteristic heavy filaments.

5. **Model Machinery** - Complete shop facilities for developing and fabricating experimental machinery.

6. **Special Textile Laboratory Facilities Include the Following:**

   a. Wool scouring and carding equipment.

   b. Cotton skein mercerizing apparatus with special strain gage tensiometer.

   c. Instruments adapted for single fiber studies; Schaevitz fiber tester; modified vibroscope; polarizing microscope; and dielectric constant apparatus for characterization of wool fibers at microwave frequencies.

   d. Instruments and equipment for evaluation of fiber, yarn, cord and fabric properties and finishes as specified by the American Association of Textile Chemists and Colorists (AATCC) and the American Society for Testing Materials (ASTM).

C. LEATHER AND TANNING MATERIALS

1. **Tanning Materials -** A complete integrated pilot-plant is under construction for grinding and continuously extracting dried tannin-bearing roots and plants, for purification of the extract by fermentation and centrifuging, for concentration of purified extracts and for spray drying them. Facilities will include a continuous counter-current leaching machine, filters, fermenters, clarifying tanks, centrifuges, multiple-effect evaporators and spray driers. Present complementary semi-works equipment includes autoclaves, evaporators and drum driers.

2. **Leather Tanning -** Vats for rocker tannage of hides, vats and drums for still tannage of heavy leather, and Meissner mills for tanning small skins.

3. **Special Laboratory Facilities Include:** Equipment for preparation, extraction and analysis of tanning materials, and equipment for determining the physical and chemical properties of leather.

D. ELASTOMERS, HIGH POLYMERS, PLASTICS AND PAINTS

1. **Guayule Rubber -** Complete facilities for preparation of deresinated guayule rubber include parboiler, defoliation equipment, hammer mill, cutter, crushing rolls, tube and pebble mills, jordan, high pressure hydraulic decorker, continuous Byrd centrifuge, scrub mill, tray driers, solvent deresination equipment and solvent recovery still.

2. **Special Synthetic Rubber-Like Elastomers** - Polymerization apparatus, compounding equipment, rubber rolls and Banbury mixers, calender rolls, and hydraulic presses.

3. **Plastics** - Complete model facilities for resin manufacture, preparation of fillers, and of molding compounds, including high temperature presses, compression and flash-type molds, an extrusion machine, equipment for embedding specimens, and a glue spreader and high frequency electronic heater for laminating; also Sigma blade mixers, Banbury mixers and differential rolls.

4. **Paints** - Complete facilities are available for modification of drying oils (such as castor, tung, safflower, cottonseed, peanut, soybean, okraseed, and sesame) to improve their properties, and for formulation of paints, varnishes, lacquers and emulsion paints, including such equipment as roller colloid mill.

5. **Special Laboratory Facilities Include:** Compounding, vulcanizing, and physical testing equipment for evaluating properties and performance characteristics over a wide range of temperature and humidity conditions; shaker and stirrer type autoclaves for high pressure reactions; high vacuum distillation equipment; ultracentrifuges; light scattering apparatus, electrophoresis apparatus for characterizing high polymers; also small-scale equipment for esterification and hydrogenation of oils

E. ALLERGENS, MEDICINAL AND THERAPEUTIC AGENTS, AND PHARMACOLOGY

1. **Allergens** - Facilities for chemical and immunological characterization of allergens include general and special laboratory equipment for organic, microbiological and immunological operations. A stock colony of in-bred and line-bred guinea pigs, with production of 100 animals per month, is available with cage equipment for individual maintenance of 300 guinea pigs. Special facilities include a 10,000-volt electrophoresis apparatus for preparative operations, a Tiselius electrophoresis apparatus, microanalytical (Pregl) equipment, equipment for rapid concentration of solutions, and a kymograph.

2. **Medicinal and Therapeutic Agents** - Complete pilot-scale facilities for preparation of biological chemicals from plant or animal sources include shredders, cutters, choppers, grinders, pulverizers, continuous presses, apron and rotary driers, batch and continuous counter-current extractors, liquid-liquid and liquid-solid extractors, continuous centrifuges and evaporators, filter presses, vacuum driers, and fermentation apparatus with supercentrifuges. Separate facilities are available for protein isolation from oilseeds, for large-scale use of inflammable solvents and for small scale processing of toxic materials.

Special laboratory facilities include the following in addition to smaller-scale versions of the pilot plant apparatus: Supersonic cell disintegrators, turbo-mixers, isolation and assay equipment, microorganism cultivation facilities, ion-exchange equipment, high boiling purification units, batch type laboratory-scale equipment for starch sponge manufacture, and rooms for testing under controlled climatic conditions.

3. **Pharmacology** - A separate pharmacology laboratory is maintained to evaluate health hazards of agents derived from agricultural commodities such as may be used in foods, insecticides, or medicinals. In this connection, facilities are available for chronic toxicity investigations on animals, including histopathological study equipment.

4. **Antibiotics** - Complete facilities for screening microorganisms for antibiotic-producing capabilities, laboratory and pilot plant production of antibiotics by fermentation (including both large and small stainless-steel fermentors), and assay of product.

F. **CULTURE COLLECTION** - Although belonging functionally with the preceding Section E, the Bureau's unique Culture Collection is considered here as a separate entry for proper emphasis. Currently the Collection, one of the world's largest, consists of about 5600 separate strains including 2500 molds, 1900 yeasts and 1200 bacteria and actinomycetes. Also, there are almost as many strains of unknown potentialities which have been collected and are maintained in desiccated form, constituting a potentially valuable reservoir of additional fermentative agents. Through active collaboration with other institutions, the Culture Collection is continually being augmented and enriched.

In addition to all necessary equipment for isolation and identification of these microorganisms, complete facilities are available for large-scale application of promising fermentation processes, particularly in the fields of antibiotics, vitamins and industrial chemicals.

G. **PAPER, PACKAGING AND BOXBOARD PRODUCTS**

1. **Paper and Board Pulps** - Complete pulp processing and testing facilities for evaluation of any plant material. Equipment includes Hydrapulpers for atmospheric pulping; high pressure digesters for any type of pulping, including those processes using nitric acid and organic pulping agents; screening, bleaching and sheet making apparatus, and physical testing apparatus specified by Technical Association of the Pulp and Paper Industry (TAPPI).

2. **Heavy Boxboard Pulps** - In addition to the equipment listed above, facilities include rotary boilers, refiners; driers; and high-temperature, hydraulic, board-forming presses.

H. **INDUSTRIAL CHEMICALS** - Special facilities, in addition to those already listed in connection with other fields of work, include the following:

1. **Alcohols from Carbohydrates** - Complete facilities for production of alpha amylase and maltase by submerged cultures, concentration and purification of enzymes, and for determination of enzyme activity and product yields. In addition to stainless steel fermenters of 7 to 4',000 gallon capacity, a complete alcohol plant is available capable of mashing 300 bushels of grain per day The pilot-plant fermentation, distillation, and byproduct recovery facilities include grinding, mashing, sterilizing, seed propagating, fermenting, and distilling equipment, including a distillation unit for production of absolute alcohol.

   Facilities for evaluation of alcohols in motor fuels include equipment for road and chassis dynamometer testing of engines, as well as for road octane ratings, fuel consumption and general performance testing. Engine testing facilities include stationary units equipped with all necessary instrumentation for measuring fuel efficiency plus special equipment for wear and manifold distribution tests. Single-cylinder engine fuel testing equipment includes ASTM-CFR variable compression-ratio engines for cetane rating and for motor, research and aviation octane ratings Special equipment is available for determination of fuel and lubricant properties in accordance with ASTM and related procedures, and for studying the corrosion of metals in both aqueous and non-aqueous systems.

2. **Pine Gum Chemicals.** - A complete batch pilot-plant for processing pine gum includes filters, pumps tanks and a continuous still. Special laboratory facilities are available for research directed toward converting turpentine and rosin into new and useful derivatives.

3. **Surface Active Agents** - Pilot-plant facilities are available for producing surface active agents if warranted; laboratory apparatus and equipment are available for synthesis as well as for chemical and physical testing of wetting agents and detergents

I **MISCELLANEOUS INDUSTRIAL PRODUCTS**

1. **Abrasives from Ground Residues** - Grinding mills of various types and sizes include attrition, hammer and roller mills; along with appropriate screens, cyclones and air classifiers.

2. **Adhesives from Starches and Proteins** -Facilities for preparation and evaluation of adhesives include a horizontal dextrinizer for preparation of starch pyrodextrins; equipment for preparing chemically modified starches and proteins; spreading coating and laminating equipment for preparation of plied paper and wood; and testing equipment for measuring viscosity, tack and adhesion.

3. **Core Binders from Cereals (for Oil Well Drilling) -** Equipment includes milling and starch processing facilities to handle any cereal grain; hot roll equipment for pregelatinized flours and starches; and analytical facilities for starch evaluation.

Research Qualifications: Laboratory Facilities Arranged According to Function

In addition to preparation and processing facilities, biological, chemical, and physical laboratory facilities are available for isolation, characterization, modification, and evaluation of compounds and products derived from agricultural sources.

A. **Preparation and Processing -** Micro- and macro-scale.

Acid conversion facilities for flour and starch
Autoclaves
Beaters - pulp
Blending equipment - liquids and solids
Centrifuges - conventional and refrigerated
Colloid mills
Crystallizers
Cyclic molecular stills
Distillation equipment - including high vacuum
Distillation equipment - including Podbielniak fractionating columns
Driers - see index for specific types
Enzyme conversion facilities for starch
Evaporating equipment
Extraction equipment - solvent type
Fermentation facilities - fermenters, autoclaves, hot air sterilizers, shakers, aerators and lyophilizing apparatus
Film preparation equipment
Filtration equipment
Grain classifying equipment - includes oilseeds
Grain cleaning and sampling equipment - includes oilseeds
Grain cracking and flaking equipment - includes oilseeds
Grinding mills - including attrition, roller, sugar and flouring types
Hydrogenation equipment - including high and low pressure facilities
Ion-exchange equipment
Irradiation equipment
Milling facilities - dry and wet
Mixers - constant and variable speed types
Oil refining equipment - vegetable oils
Oxidation equipment - catalytic and non-catalytic, including selenium and mercury arc rectifiers and ozone generators
Plastic embedding equipment

Presses - hydraulic and manual types
Pulping equipment - pressure and atmospheric
Radioactive tracer equipment
Sterilizing equipment - hot air and steam
Super-centrifuges
Synthetic protein fiber extrusion and spinning facilities
Ultracentrifuges
Ultrasonic generators
Votators

B. Analytical and Physical Testing

1. **Calorimetry** - Adiabatic calorimeter

2. **Chromatography** - Equipment for qualitative and quantitative analysis by both paper and column techniques

3. **Colorimetry** - (See also Spectrophotometry)

Hunter color and color-difference meters
Multipurpose color reflectometers
Munsell color charts and discs
Oil color spectrometer
Photometers

4. **Dialysis** - Continuous dialyzers

5. **Dielectrics** - Apparatus to measure dielectric constants, resistance, and capacitance at audio frequencies.

Radio impedance bridges
Vacuum tube audiometers

6. **Film Testing Equipment - Paints, Rubbers and Other**

Abrasion resistance
Aging - accelerated moisture, ultraviolet and weathering exposure
Bursting strength
Drying time apparatus
Elongation
Flex resistance
Folding endurance
Gas, haze, and water vapor permeability
Hardness
Rebound
Reflectance and gloss
Stiffness
Stress-strain characteristics
Tear strength
Tensile strength

7. **Ion-Exchange Equipment**

8. **Ionophoresis Equipment**

9. **Leather Testing Equipment**

Abrasion resistance
Breaking strength
Bursting strength
Elongation
Flex resistance
Perspiration resistance
Photometer and Munsell color equipment
Stiffness
Tear strength
Water resistance

10. **Microbiological Testing** - Completely equipped laboratory units with facilities for conducting isolation, characterization, and evaluation studies. Equipment includes apparatus for propagation, aeration, concentration, drying, inoculation and incubation; also standard biological and biochemical equipment for isolation, culture and identification of molds, yeasts and bacteria.

11. **Microscopy**

Electron microscope - including metal shadowing unit
Optical microscopes
Petrographic microscopes
Phase microscopes
Photomicrography apparatus
Polarizing microscopes
Stereoscopic microscopes

12. **Molecular Weight**

Electrophoresis and conductivity apparatus
Light scattering apparatus - molecular turbidity
Osmotic pressure equipment
Ultracentrifuges
Viscosity apparatus

13. **Pharmacological Testing** - Completely equipped laboratory units, including small-animal rooms, for making acute and chronic toxicity determinations and studying the physiological function of active compounds.

14. **Photographic Facilities - Including Complete Dark Room Equipment**

Cameras (See also X-ray facilities)
Enlargers
Motion picture apparatus

Ozalid process equipment
Photomicrographic equipment
Photostatic equipment

15. Plastics and Plywood Testing

Abrasion resistance
Absorption
Compressive strength
Crack resistance
Degree of cure
Flexural strength
Flow properties
Hardness
Impact strength
Shear strength - block and strip
Stiffness
Tensile strength

16. Polarimetry

Polariscopes
Polarizing microscopes
Saccharimeters

17. Polarography

Polarographs

18. Pulp, Paper and Insulating Board Testing

Basis weight
Board formation - test pieces
Brightness
Bursting strength
Compressibility
Consistency
Crush strength
Densometer
Flexural strength
Folding endurance
Freeness
Hardness
Impact strength
Moisture meter
Puncture strength
Tensile strength

19. Radioisotope Tracing Equipment

Counter apparatus - with scaling equipment

20. Refractometry

Differential refractometer

21. Sedimentation Velocity

Diffusion cells
Ultracentrifuges

22. Spectrography

Densitometers - recording type
Emission spectrograph

23. Spectrophotometry - (See also Colorimetry)

Flame photometers
Infrared photometers
Microwave spectrometers
Radio frequency spectrometers - for measuring nuclear magnetic resonance
Ultraviolet spectrophotometers
Visible range recording spectrophotometers
X-ray spectrometers

24. Stability to Aging - Accelerated and Natural Aging Equipment

Fadeometer - accelerated ultraviolet exposure
Outdoor exposure facilities
Oxidation - catalytic and non-catalytic
Oxidation - reduction potential apparatus
Storage deterioration
Weatherometer - accelerated weathering

25. Surface Activity Measuring Apparatus

Detergency
  Launderometer for textile testing
  Special Western Regional Research Laboratory multiple-unit apparatus
Foaming
Interfacial tension
Surface tension
Wetting - textile testing

26. Textile Fiber, Yarn and Fabric Testing Apparatus

Abrasion resistance - fabric
  Stoll-Quartermaster apparatus
  Taber Abraser

Colorfastness - yarn and fabric
  Fadeometers
  Launderometers
Count - yarn
Crease resistance - fabric
  American Cyanamid tester
  Monsanto tester
Crimp - fiber
Elongation - fiber, yarn and fabric
  Instron tester
  Scott testers
Evenness - fiber, sliver, roving and yarn
  Fibrograph
  Saco-Lowell tester
  Special Southern Regional Research Laboratory tester
  Uster evenness tester
Fineness - fiber
  Arealometer
  Micronaire
Flammability - fabric
Flex resistance - cord
  Special Southern Regional Research Laboratory apparatus
Heat resistance - yarn and fabric
Length - fiber
  Fibrograph
  Suter-Webb apparatus
Maturity - cotton fiber
  Conventional and special
  Southern Regional Research Laboratory tests
Perspiration resistance - fabric
  AATCC apparatus
Soil resistance - fabric
  Launderometer
  Special Western Regional Research Laboratory multiple-unit detergency tester
Stiffness - fabric
  Gurley tester
Strength - fiber, yarn and fabric
  Instron tester
  Pressley tester (fiber)
  Scott testers
Stress-strain properties - fiber, yarn and fabric
  Instron tester
  Schaevitz fiber tester
Tear strength - fabric
  Scott testers
Twist - yarn and cord
Uniformity - fiber, sliver, roving and yarn - see "evenness"
Warmth - fabric
  Special Southern Regional Research Laboratory apparatus
Water resistance - fabric
  Air and water permeability testers
  AATCC rain testing and spray rating apparatus

Bundesman rain tester
Drop penetration tester
Weather resistance
Outdoor exposure facilities
Weatherometers

27. **Ultrasonics** - generators

28. **Viscosity**

Capillary tube viscometers
Falling ball viscometers
Plastic flow tester
Rotational viscometers
Torsion viscometers
Universal plastics tester

29. **X-ray Equipment**

X-ray camera equipment
Buerger precision camera
Flat cassette cameras
Circular cassette cameras
Goniometers
Weissenberg camera
X-ray diffraction units
X-ray spectrometers

EXAMPLES OF PAST ACHIEVEMENTS

Bureau scientists have been granted a large number of patents, of which 500 have been issued within the past ten years. During this same period Bureau scientists have issued more than 3300 publications on the results of their investigations, some of which have had a profound influence on our lives.

Many of the Bureau's developments have been of great interest to Defense Agencies whose cooperation was a vital factor in their success. A few examples of such developments are given below:

1. The vital drug penicillin was made commercially available in time for use during World War II as a direct result of research in the Bureau's Northern Laboratory which increased the yield of the drug 100 times.

2. The production of rutin from buckwheat, developed in the Bureau's Eastern Laboratory, focused attention on this drug for treatment of patients with symptoms of increased capillary fragility and permeability. Currently the Department of Defense is evaluating the administration of rutin to military personnel in frigid regions for the reduction of injury by cold.

3 A new type of conforming bandage developed by the Bureau's Southern Laboratory, in tests conducted by the Research and Development Board of the Surgeon General's Office in Army hospitals and in field stations in Korea performed better than any other types available for securing newly developed special dressings to multiple wounds and large burned areas This bandage is now being manufactured on a commercial scale and eventually will be available for civilian as well as military use

4 The Quartermaster Food and Container Institute, Chicago, Illinois, has cooperated with the Bureau's Western Laboratory in the development of a new process for the manufacture of dried egg powders which retain their palatability after storage for long periods of time, even at elevated temperatures

Brief mention can be made of other Bureau achievements which are of interest to both military and civilian agencies

1 The Bureau has developed a starch derivative known as allyl starch, which has considerable promise as a varnish with high resistance to heat, oils and organic solvents At present it is being manufactured on a limited commercial scale and is finding application in printing inks as a paper and textile coating and in various other special applications

2 Another example of the Bureau's work adopted by industry involves the utilization of poultry feathers Processed into meal, feathers are used as an organic nitrogen fertilizer Feathers also may be cooked and dissolved, then extruded in filament form to provide an excellent regenerated protein paint brush bristle A large paint brush manufacturer now is preparing to produce feather protein bristles in sizable quantities

3 The Bureau's pioneering investigations have led to improvements in the quality of dehydrated, canned and frozen fruits and vegetables, concentrated fruit juices concentrated maple products, peanut butter and food products from oilseeds

4 The Bureau has gained recognition for its work directed toward increasing yields improving processing and raising quality standards to promote greater utilization of many other products and by-products Bureau scientists have developed methods for the production of high quality dextran, one of the most promising of the blood plasma extenders they also have developed new, more efficient cotton processing machinery radically improved cotton fabrics, and worked out a continuous process for the manufacture of textile fiber from zein the corn protein This corn protein fiber now is produced commercially and is well known to the textile trade

5 The Bureau's work on guayule rubber and pine gum chemicals has resulted in process simplification and higher quality products, some of which are of considerable interest to the Armed Forces

6. Mention should be made, too, of the Bureau's contributions to the more efficient production of certain vitamins, drugs, and industrial plasticizers.

The Bureau also is continuously striving to develop the economic utilization of agricultural residues such as straw, sugarcane bagasse, corncobs, rice hulls, nut shells and fruit pits, as well as to divert dairy and cannery wastes into useful channels.

LIAISON OPPORTUNITIES AND EXAMPLES OF COOPERATIVE WORK

The location of the Bureau's central staff in Washington affords an excellent opportunity for effective liaison with both federal and industrial groups with common interests. The Bureau regularly receives recommendations from about 25 committees, both commodity and functional, set up by the Department of Agriculture under the Research and Marketing Act of 1946 for the purpose of advising the Agricultural Research Administration on specific phases of its program, particularly from the standpoint of the long-term research needs of American Agriculture. These committees enlist the services of about 400 advisers representing private industry, farm organizations, university laboratories and consumer groups. Representatives of industry and other Government agencies also function in an informal advisory capacity to develop a well-integrated research program.

It is generally recognized that in order to be prepared to meet emergencies, our country's total research facilities should be mobilized on a nationwide stand-by basis to guarantee their most effective use. Accordingly, research organizations, both in and outside the government, have been making increased use of the Bureau's storehouse of knowledge and research facilities. To insure that the Bureau's research efforts are in accord with emergency needs, frequent consultations are held with agencies within the Department of Defense.

The Bureau is maintaining especially close-working relationships with the Research and Development Division of the Quartermaster Corps. In June, 1950, Dr. G. E. Hilbert, Chief of the Bureau, arranged with Dr. A. S. Hunter, Director of the Quartermaster Research and Development Division, for the appointment of special liaison representatives. Dr. Walter M. Scott was selected to represent the Bureau and Dr. R. G. H. Siu to represent the Quartermaster Corps. After about a year of cooperative effort, these liaison representatives prepared a joint report which indicated the responsible technical personnel of each agency concerned with research of mutual interest and gave a summary of Quartermaster research problems and of the Bureau research activities which were of interest to the Quartermaster.

The Chief of the Bureau is a member of the Panel on Food of the Research and Development Board of the Department of Defense, which advises the Secretary of Defense, and of the Committee on Foods of the National Research Council Advisory Board on Quartermaster Research and Development, which advises the Quartermaster General on food research. Several members of the Bureau staff serve on Subcommittees of the Committee on Foods. Other representatives of the Bureau serve on the Textile, Rubber, Leather, Fats and Oils and Chemical Subcommittees of the Munitions Board in the Office of the Secretary of Defense.

Examples of the Bureau's projects, which have been initiated after consultation with interested Defense Agencies and with their cooperation, are given below.

High-protein emergency military rations
Dehydrated foods
Concentrated fruit juices
Global edible spreads
Global lubricating greases
Improved jet propellants and lubricants
Rot- and weather-resistant cotton textiles
Improved leather for shoes
Bread staling research[1]
Dehydration of sweet potatoes[1]
Dehydration handbook[1]
Flameproofing of cotton fabrics[1]
Universal dry cleaning and detergent liquid for use in the field[2]
Improved cotton cartridge cloth[2]
Plant growth regulators[3]
Preparation of cholinesterase[3]
Bacterial toxins[3]
Toxoids and vaccines[3]

[1] Supported in part by Army Quartermaster funds
[2] Supported in part by Army Ordnance funds
[3] Supported in part by Army Chemical Corps funds

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